

(19) 日本国特許庁 (J P)

(12) 公表特許公報 (A)

(11) 特許出願公表番号

特表2002-532867

(P2002-532867A)

(43) 公表日 平成14年10月2日 (2002.10.2)

(51) Int.Cl.<sup>7</sup>

H 0 5 B 41/282

41/24

識別記号

F I

H 0 5 B 41/24

41/29

テマート\* (参考)

Z 3 K 0 7 2

C

審査請求 未請求 予備審査請求 未請求 (全 16 頁)

(21) 出願番号 特願2000-589009 (P2000-589009)

(86) (22) 出願日 平成11年12月2日 (1999.12.2)

(85) 翻訳文提出日 平成12年8月17日 (2000.8.17)

(86) 国際出願番号 PCT/EP99/09594

(87) 国際公開番号 WO00/36883

(87) 国際公開日 平成12年6月22日 (2000.6.22)

(31) 優先権主張番号 98204287.1

(32) 優先日 平成10年12月17日 (1998.12.17)

(33) 優先権主張国 欧州特許庁 (EP)

(81) 指定国 EP (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), CN, JP, KR

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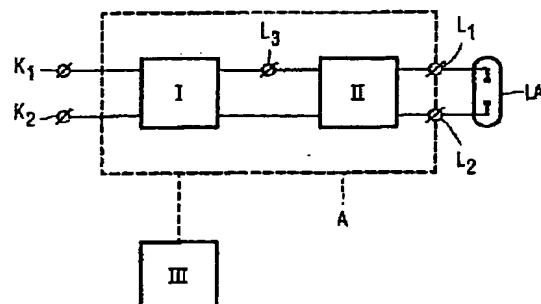
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(54) 【発明の名称】 回路装置

(57) 【要約】

本発明は、供給電圧源に接続する入力端子 (K1, K2) と、前記高圧放電ランプを接続する出力端子と、前記入力端子に結合され、交流ランプ電流を高圧放電ランプに供給する手段とを有する高圧放電ランプを点灯する回路装置に関する。ランプ電流は期間毎に平均値  $I_m$  を持つ。本発明によれば、前記ランプ電流が、各期間の開始において、陰極フェーズの電極に対する安定した拡散的アタックを許容するように、前記平均値  $I_m$  に対して低くされている。前記回路装置は、とりわけ、光学投影システムにおいてランプを点灯するのに適している。



**【発明の詳細な説明】****【0001】****【技術分野】**

本発明は、点灯中に陰極フェーズ(cathodic phase)にある電極を持つ高圧放電ランプを点灯する回路装置であって、

—供給電圧源に接続する入力端子と、

—前記高圧放電ランプを接続する出力端子と、

—前記入力端子に結合され、双極性の連続する期間(periods)を持つ交流ランプ電流を前記高圧放電ランプに供給する手段とを有し、該ランプ電流は期間毎に平均値  $I_m$  を持つ回路装置に関する。

**【0002】****【背景技術】**

このような回路装置は、米国特許第US 5608294号から既知である。既知の回路においては、各期間におけるランプ電流に、各期間の後半部分において電流パルスが重畳されている。高圧放電ランプが交流電流で点灯される場合、ランプの各電極は、ランプ電流の連続する期間中に陰極及び陽極として交互に機能する。それら連続する期間中、ランプ電流を放出する電極は陰極フェーズにある及び他方の電極は陽極フェーズにあると各々言える。ランプを流れる電流の総量が、電流パルスによりランプ電流の各期間の終わりににおいて増加されるため、電極の温度は、放電アークの安定性を増大させるように十分に上昇される。従って、高圧放電ランプのちらつき(flickering)をかなり抑制することができる。自身のちらつきを抑制する特性により、上記回路装置は、とりわけ、投影テレビジョン装置のような投影システムにおいて高圧放電ランプを点灯するのに適している。

**【0003】**

既知の回路装置で点灯されたランプは、数百時間の点灯時間にわたってアーク電圧の連続的な上昇を持つことを示した。このような電圧の上昇は、ランプを数千時間実験的に点灯した場合連続して現れた。ランプの寿命にわたりかなり一定であるランプの安定した発光出力は、投影システムにおける使用に極めて重要で

従来技術を越えるような顕著な向上はないことを実験が示した。比  $t_1 / t_p$  の上側の値は、妥協(compromise)に依存する。拡散的な安定したアタッチメント(diffuse stable attachment)に対して、上記比はできるだけ長くすべきである。しかしながら、陰極は陰極フェーズ中に冷却する傾向があり、故に、拡散的な安定したアタッチメントで持って放出される電流が低減する傾向があるので、これは要求された出力定格でランプを点灯し続ける必要性とコンフリクトする。故に、実験的に、前記期間の第1部分における増加する電流形状に対して、前記比は好ましくはせいぜい0.5であるべきである、ということが示された。 $t_1$ 中減少する電流の状況においては、最大比を0.85とすることができる。他の点においては、電流  $I_e$  及び  $I_m$  の値に対して、結果として従来技術と比較し電極への余分な負荷の減少をもたらすように、 $0.3 \leq I_e / I_m \leq 0.9$  を示す、好ましくは、 $0.6 \leq I_e / I_m \leq 0.8$  を満足する関係を成り立たせるべきである、ということが見られた。 $I_e > 0.9 I_m$  の電流値に対しては、顕著な効果が見られなかった。 $I_e$  が  $I_m$  に対して極めて低くなる場合、前記期間の第2部分における平均電流の値  $I_2$  は、結果としてランプのちらつきをもたらすような、該期間の第2部分中にアークの不安定が発生する重大な危険性が存するほど高く選択されなければならない。

#### 【0008】

更に好ましい実施例においては、前記期間の開始における電流が  $I_e$  よりも高い。このようにして、陰極温度が前記期間中に低下し、斯くして、それに従ってアークの安定した拡散的アタッチメント(stable diffuse attachment)が成り立つ電流値が低下する、ということが有利にして考慮される。

#### 【0009】

アークの安定化及びその結果としてランプフリッカの減少が、従来技術から既知のようにランプ電流に付加的な電流パルスが付加することにより更に一層促進される。好ましくは、この場合、前記ランプ電流に、前記期間の終わりににおいて同一極性の、関係  $I_3 \leq 2 I_m$  を満たす値  $I_3$  を持つパルスが設けられる。

#### 【0010】

本発明の上述の及び他の特徴を、図を参照して以下により詳細に説明する。

れる電圧は、ランプ点弧回路において発生される点弧電圧により乱されない直流電圧であるからである。制御手段ⅠⅠⅠは、更に、手段Ⅰのスイッチモード電力回路を形成する、少なくともスイッチを有する上記コンバータの誘導手段Lを流れる電流を検出するための入力部2、及び導通状態及び非導通状態に周期的にスイッチモード電力回路のスイッチを切り替え、斯くして、前記コンバータの誘導手段Lを流れる電流を制御するための出力端子3とを持つ。入力部1は、マイクロコントローラMCの接続ピンP1に接続されている。マイクロコントローラの接続ピンP3は、スイッチング回路SCの入力部4に接続されている。入力部2は、スイッチング回路SCの入力部5に接続されている。スイッチング回路SCの出力部Oは、出力端子3に接続されている。

#### 【0015】

バック即ちダウンコンバータであるコンバータを有する図2に示される回路装置の動作は次の通りである。マイクロプロセッサMCには、ランプ電圧、時間の組み合わせにラベルが付されたコンバータのピーク電流値のマトリックスを含むソフトウェアが設けられている。斯様に見出されるコンバータのピーク電流値は、入力部4においてスイッチング回路SCに供給され、そして入力部5においてスイッチング回路SCにも供給される、入力部2において検出された電流に対する比較基準として用いられる。この電流値の比較に基づいて、スイッチング回路は、出力部Oにおいてスイッチオフ信号を発生する。これは、検出された電流がピーク電流値に等しい場合にダウンコンバータのスイッチを非導通状態に切り替える。結果として、誘導手段Lを流れる電流が減少するであろう。コンバータのスイッチは、誘導手段Lを流れる電流が零になるまで非導通状態に保持される。コンバータ電流が零になることを検出すると、スイッチング回路SCは、ダウンコンバータのスイッチを導通にするスイッチオン信号を出力部Oにおいて発生する。ここで、誘導手段Lを流れる電流は、ピーク電流値に到達するまで増加を開始する。そのようなスイッチング回路SCは、例えば、国際特許出願公開第WO97/14275号から既知である。ピーク電流の値は、ランプ電圧が制御手段ⅠⅠⅠにより検出される度毎にリフレッシュされる。

#### 【0016】

図6は、更に他の好ましい実施例による電流のグラフを示している。この実施例においては、ランプ電流に、当該期間の終わりにおいて同一極性の値  $I_3$  を持つパルスが設けられている。上述の実施例を実際に実現するに当たり、 $I_3$  の値は、 $1.6 I_m$  である。

#### 【0021】

上述の回路装置の実用的な実施例を、フィリップス社製のタイプUHPの高圧放電ランプの点灯用として用いた。このランプは、100Wの公称消費電力を有し、わずか1.3mmの電極距離を持ち、図4による電流で点灯された。電流の値は、 $I_e = 0.93A$ 、 $I_m = 1.25A$ 、 $I_2 = 1.33A$  である。故に、比  $I_e / I_m$  は0.74である。期間の継続時間  $t_p$  は、90Hzの整流手段  $I$  の動作周波数に応じて5.6msであり、比  $t_1 / t_p$  は0.2である。マイクロプロセッサMCとして、フィリップス社製のP87C749EBPが、各期間中2回ランプ電圧を検出するようにプログラムされる場合に適切であることを示した。図6による電流パルスが各半期間の後半8%の間ランプ電流に重畳され、その結果として $1.4 \times I_m$ の電流  $I_3$  となるような他の実用的な実施例において、ちらつきをかなり抑制することができた。

#### 【0022】

ランプ電圧は、100時間のランプライフにおいて85Vであり、500時間の点灯後94Vへの増加を示した。比較のために、従来技術による回路装置で同一のランプを点灯させた。この場合においては、ランプ電圧が、100時間における85Vから、わずか300時間の点灯後110Vに増加した。

#### 【図面の簡単な説明】

##### 【図1】

本発明による回路装置の概略的な図を示している。

##### 【図2】

図1の本発明による回路装置の実施例の制御手段を示している。

##### 【図3】

図1による装置により提供されるランプ電流のグラフである。

##### 【図4】

【図1】

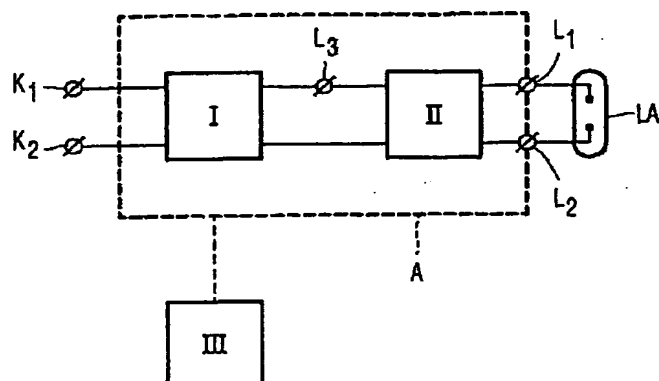


FIG. 1

【図2】

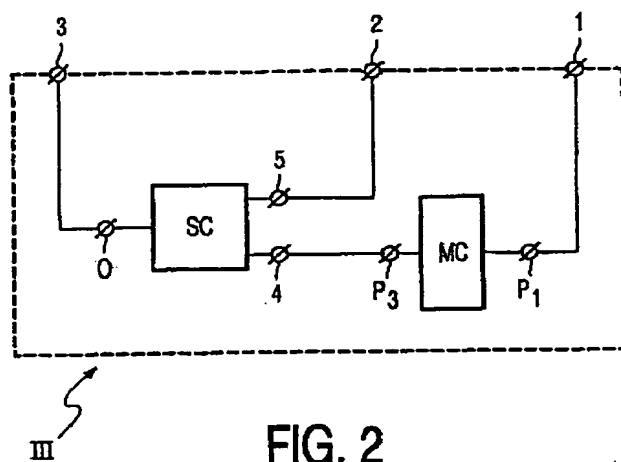


FIG. 2

【図5】

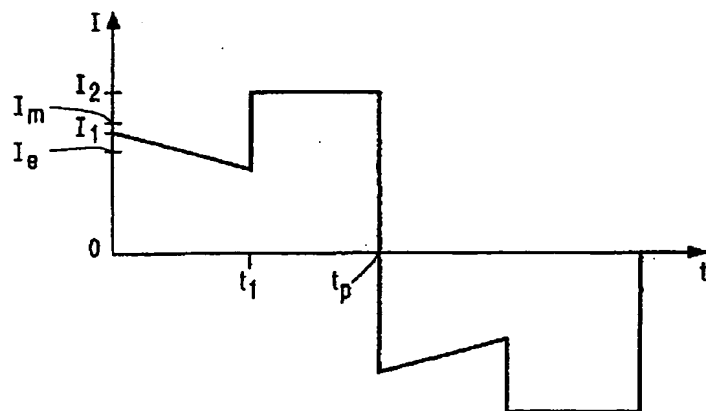


FIG. 5

【図6】

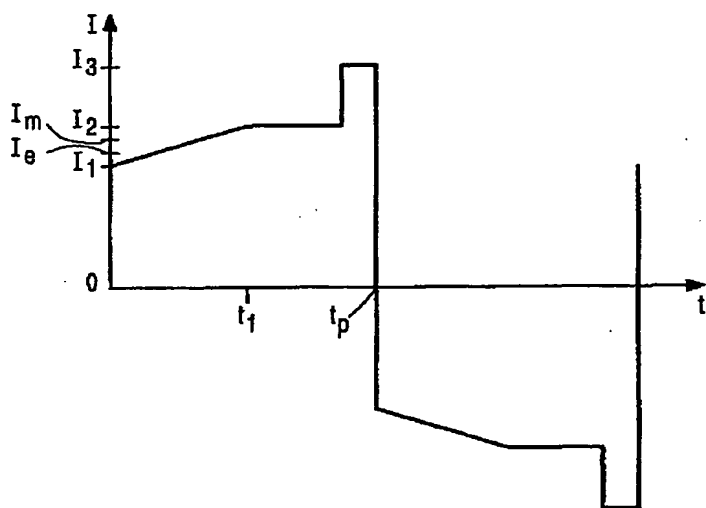


FIG. 6

## INTERNATIONAL SEARCH REPORT

Information on patent family members





International Application No  
PCT/EP 99/09594

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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**CIRCUIT ARRANGEMENT**

**Patent number:** WO0036883  
**Publication date:** 2000-06-22  
**Inventor:** DERRA GUNTHER H; FISCHER HANNS E; GANSER HANS G; KRUECKEN THOMAS; MOENCH HOLGER; SNIJKERS ROB  
**Applicant:** KONINKL PHILIPS ELECTRONICS NV (NL); PHILIPS CORP INTELLECTUAL PTY (DE)  
**Classification:**  
- international: **H05B41/292; H05B41/28; (IPC1-7): H05B41/292**  
- european: **H05B41/292L**  
**Application number:** WO1999EP09594 19991202  
**Priority number(s):** EP19980204287 19981217

**Also published as:**

 US6239556 (B1)  
 DE69921616T (T)  
 DE69921616D (T)  
 CN1166258C (C)

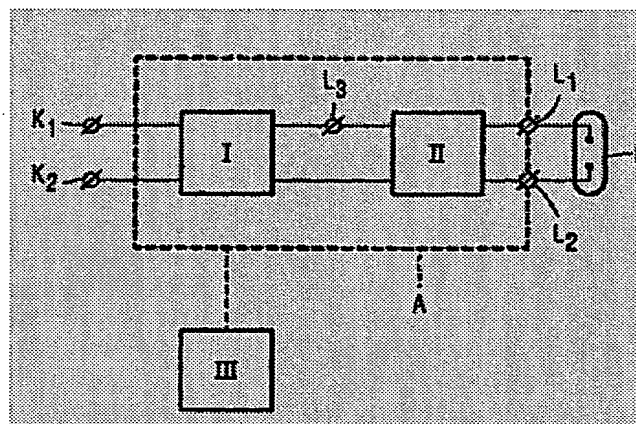
**Cited documents:**

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 US5608294  
 DE4410177

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**Abstract of WO0036883**

The invention is concerned with a circuit arrangement for operating a high pressure discharge lamp comprising input terminals (K1, K2) for connection to a supply voltage source, output terminals for connecting the high pressure discharge lamp, and means, coupled to the input terminals, for supplying an alternating lamp current to the high pressure discharge lamp. The lamp current has per period a mean value  $I_m$ . According to the invention the lamp current in each period at its start is lowered with respect to the mean value  $I_m$  so as to allow for stable diffuse attachment on the cathodic phase electrode. The circuit arrangement is in particular suited for operating a lamp in an optical projection system.



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CLAIMS

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[Claim(s)]

[Claim 1] The input terminal which is the circuit apparatus which turns on the high-pressure discharge lamp which has an electrode in a cathode phase during lighting, and is connected to the source of - supply voltage, - It is combined with the output terminal which connects said high-pressure discharge lamp, and the - aforementioned input terminal. Having a means to supply an alternating current lamp current with the period when a bipolar continues to said high-pressure discharge lamp, this lamp current is a circuit apparatus which has the average  $I_m$  for every period. Said lamp current sets to initiation of each period. The circuit apparatus characterized by the low thing to said average  $I_m$  so that the stable diffusion-attack to the electrode of a cathode phase may be permitted.

[Claim 2] The circuit apparatus according to claim 1 characterized by said lamp current having the average  $I_m$  for every period, covering a part for part I of this period, having the lower average  $I_e$ , covering a part for part II of this period, and having the larger average current  $I_2$  than  $I_m$ .

[Claim 3] It is the circuit apparatus according to claim 1 or 2 characterized by for said period having Duration  $t_p$  and the amount of [ of this period ] said part I having the duration  $t_1$  with which the relation of  $0.05 \leq t_1/t_p \leq 0.85$  is filled.

[Claim 4] The circuit apparatus according to claim 1, 2, or 3 characterized by being  $0.3 \leq I_e/I_m \leq 0.9$ .

[Claim 5] The circuit apparatus according to claim 2, 3, or 4 with which the current in initiation of said period is characterized by being higher than  $I_e$ .

[Claim 6] A circuit apparatus given in claim 1 characterized by establishing the pulse which has the value  $I_3$  with which the same polar relation  $I_3 \leq 2I_m$  is filled in the end of said period in said lamp current thru/or any 1 term of 5.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]

the input terminal which this invention is a circuit apparatus which turns on the high-pressure discharge lamp which has an electrode in a cathode phase (cathodic phase) during lighting, and is connected to the source of - supply voltage, and - the output terminal which connects said high-pressure discharge lamp, and - it is combined with said input terminal, it has a means supply an alternating current lamp current with the period (periods) when a bipolar continues to said high-pressure discharge lamp, and this lamp current is related with the circuit apparatus which has the average  $I_m$  for every period.

[0002]

[Background of the Invention]

such a circuit apparatus -- the [ United States patent ] -- it is known from US No. 5608294. In the known circuit, the lamp current in each period is overlapped on the current pulse in the second half part of each period. When a high-pressure discharge lamp is turned on by alternating current, each electrode of a lamp functions by turns as cathode and an anode plate during the period when a lamp current continues. During the period which they-continues, and the electrode which emits a lamp current is in a cathode phase, it can be said respectively that the electrode of another side is in an anode plate phase. Since the total amount of the current which flows a lamp is increased by the current pulse in the end of each period of a lamp current, the temperature of an electrode fully rises so that the stability of a discharge arc may be increased. Therefore, a flicker (flickering) of a high-pressure discharge lamp can be controlled considerably. It is suitable for dividing the above-mentioned circuit apparatus and turning on a high-pressure discharge lamp in a projection system like a projection TV apparatus with the property which controls a flicker of self.

[0003]

It was shown that the lamp turned on with the known circuit apparatus has the continuous rise of arc voltage over hundreds of hours lighting time amount. The rise of such an electrical potential difference appeared continuously, when a lamp was turned on experimentally for thousands hours. Since the radiant power output by which the quite fixed lamp was stabilized over the life of a lamp is very important for the use in a projection system, the rise of continuous arc voltage serves as a serious disadvantageous point for reaching a long lamp life.

[0004]

[Description of the Invention]

the purpose of this invention -- the above -- it is in offering the circuit apparatus which turns on the high-pressure discharge lamp with which a disadvantageous point is offset.

[0005]

According to this invention, the circuit apparatus stated to the beginning paragraph is characterized by the low thing to said average  $I_m$  so that said lamp current may permit the stable diffusion-attack to the electrode of a cathode phase in initiation of each period for this purpose. The equipment concerned has

the advantage referred to as making it possible to flicker over a long period of time and to make a lamp turn on that there is nothing while a discharge arc has a soft start (soft start) in each period by attaching two electrodes in diffusion during lamp lighting, consequently it brings about a lower electrode load, therefore reduces generating of a rise of arc voltage very remarkably.

[0006]

The average  $I_m$  of the current over the period concerned corresponds to the power  $P_{la}$  of the lamp according to related  $P_{la}=I_m \times V_{la}$  with lamp voltage  $V_{la}$ . Preferably, the average  $I_e$  of the current covering a part for part I of the period concerned was smaller than the value  $I_m$ , and the experiment showed covering a part for part II of this period, and saying that the average current value  $I_2$  is larger than  $I_m$ . This brings about the attachment of the arc which raised the soft current start in the beginning of each period with the attachment of the diffusion-arc covering a part for part I of said period, consequently was stabilized further. As a result of the current  $I_2$  covering a part for part II of said bigger period than  $I_m$ , the need for the additional current pulse near the end of this period is reduced further.

[0007]

In the desirable example of the equipment by this invention, said period has Duration  $t_p$  and the amount of [ of this period ] said part I has the duration  $t_1$  with which the relation of  $0.05 \leq t_1/t_p \leq 0.85$  is filled. When the value of Ratios  $t_1/t_p$  was smaller than 0.05, the experiment showed that there was no remarkable improvement which exceeds the conventional technique. It depends for the value of Ratio  $t_1/t_p$  top on compromise (compromise). The above-mentioned ratio should be made as long as possible to the stable diffusion attachment (diffuse stable attachment). However, since cathode has the inclination which the current which tends to cool during a cathode phase, therefore is emitted by having by the stable diffusion attachment reduces, this carries out a conflict to the need of continuing turning on a lamp by the demanded output rating. Therefore, saying that said ratio should be at most 0.5 preferably was experimentally shown to the increasing current configuration in a part for part I of said period. The maximum ratio can be set to 0.85 in the situation of the current which decreases among  $t_1$ . In other points, to the value of Currents  $I_e$  and  $I_m$ , saying that the relation which shows  $0.3 \leq I_e/I_m \leq 0.9$  and with which it is satisfied of  $0.6 \leq I_e/I_m \leq 0.8$  preferably should be materialized was seen so that reduction of the excessive load to an electrode might be brought about as a result as compared with the conventional technique. Remarkable effectiveness was not seen to the current value of  $I_e > 0.9 I_m$ . When  $I_e$  becomes very low to  $I_m$ , the value  $I_2$  of the average current in a part for part II of said period must be chosen so highly that the serious danger that the instability of an arc will occur consists in the part II part of this period that brings about a flicker of a lamp as a result.

[0008]

Furthermore, in a desirable example, the current in initiation of said period is higher than  $I_e$ . Thus, cathode temperature falls during said period, thus, saying that the current value of which the diffusion-attachment (stable diffuse attachment) by which the arc was stabilized according to it consists falls makes it advantageous, and it is taken into consideration.

[0009]

Reduction in a lamp flicker is promoted further further as stabilization of an arc, and its result by adding an additional current pulse to a lamp current like known from the conventional technique. The pulse which has preferably the value  $I_3$  with which the same polar relation  $I_3 \leq 2 I_m$  is filled in the end of said period in said lamp current in this case is established.

[0010]

The description of above-mentioned [ of this invention ] and others is explained to a detail by the following with reference to drawing.

[0011]

[Best Mode of Carrying Out the Invention]

In drawing 1, I is a means with the input terminals K1 and K2 linked to the source of supply voltage which supplies supply voltage to generate the controlled direct-current supply current. The output terminal of Means I is connected to the input terminal of Commutator II, respectively. The output terminals L1 and L2 which connect a high-pressure discharge lamp La to Commutator II are formed. III

is a control means which controls the value of the current supplied to a lamp by controlling Means I. Means I and Means II are combined with said input terminal, a means to supply an alternating current lamp current with the period when a bipolar continues is built, and this lamp current has the average  $I_m$  for every period.

[0012]

The actuation of the circuit apparatus shown in drawing 1 is as follows.

[0013]

If input terminals K1 and K2 are connected to the source of supply voltage, Means I will generate direct-current supply current from the supply voltage supplied by the source of supply voltage. Commutator II is changed into alternating current with the period when a bipolar continues this direct current. It is formed in Mr. \*\* and the value of the current supplied to Lamp La is controlled by the control means III so that the stable diffusion-attack (stable diffuse attack) to the electrode of a cathode phase may be permitted and a lamp current becomes low to the average  $I_m$  in initiation of each period. In actually realizing the above-mentioned example, Means I is formed of the rectification bridge which a switch mode power circuit, for example, the back, i.e., a down converter, follows. Commutator II has all bridge circuits preferably. Moreover, a lamp gate circuit is preferably incorporated in the rectification means II.

[0014]

In drawing 2, the control means III which controls a control means I is shown more in the detail. A control means III has the input section 1 for detecting the electrical potential difference between the terminal L1 connected to the lamp, and L2 which forms the signal which shows arc voltage, for example, the arc voltage further called lamp voltage. Preferably, the signal showing lamp voltage is formed by detecting the electrical potential difference in a node L3. It says because the electrical potential difference detected by Mr. \*\* is direct current voltage which is not disturbed by the striking voltage of arc generated in a lamp gate circuit. A control means III changes the switch of a switch mode power circuit to the input section 2, the switch-on, and the non-conductive state for detecting the current which flows further the guiding means L of the above-mentioned converter which forms the switch mode power circuit of Means I, and which has a switch at least periodically, and has the output terminal 3 for controlling thus the current which flows the guiding means L of said converter. The input section 1 is connected to the contact pin P1 of Microcontroller MC. The contact pin P3 of a microcontroller is connected to the input section 4 of switching circuit SC. The input section 2 is connected to the input section 5 of switching circuit SC. The output section O of switching circuit SC is connected to the output terminal 3.

[0015]

The actuation of the circuit apparatus shown in drawing 2 which has the converter which is the back, i.e., a down converter, is as follows. Software including the matrix of lamp voltage and the peak current value of the converter by which the label was given to the combination of time amount is formed in Microprocessor MC. The peak current value of the converter found out by Mr. \*\* is supplied to switching circuit SC in the input section 4, and is used as comparison criteria to the current detected in the input section 2 supplied also to switching circuit SC in the input section 5. Based on the comparison of this current value, a switching circuit generates a switch off signal in the output section O. This changes the switch of a down converter to non-switch-on, when the detected current is equal to a peak current value. The current which flows a guiding means will decrease as a result. The switch of a converter is held at non-switch-on until the current which flows a guiding means L becomes zero. If it detects that a converter current becomes zero, switching circuit SC will generate the switch-on signal which carries out the switch of a down converter to a flow in the output section O. Here, the current which flows a guiding means L starts an increment until it reaches a peak current value. such a switching circuit SC -- the [ for example, / international patent application public presentation ] -- it is known from WO 97/No. 14275. The value of the peak current is refreshed every, whenever lamp voltage is detected by the control means III.

[0016]

Detection of lamp voltage is made as it is also at the repetition rate in each period depending on the configuration of the current which should be realized through a lamp (repetition rate), and it is controlled by the built-in timer of Microcontroller MC. Acquiring lamp voltage as a lamp parameter for detection has the advantage of making it possible to make watt control (wattage control) of a lamp including in the software of a microcontroller originally. Probably, watt control needs the additional control procedure not only in additional detection of lamp voltage but a microcontroller, when the lamp current itself is acquired as a parameter for detection. A down converter operates on the frequency of the range of 45kHz - 75kHz in a desirable example.

[0017]

The lamp current as a result which is formed in actually realizing the above-mentioned example of the circuit apparatus by this invention is shown in the graph of drawing 3 R> 3 about two continuous periods which has a bipolar. The current is set up in accordance with the axis of ordinate in the relative scale. Time amount is shown in accordance with the axis of abscissa. To the 1st period B of Duration  $t_p$ , a lamp current is crossed to a part for part I of the period concerned which has the average  $I_m$  and has duration  $t_1$ , has the lower average  $I_e$ , is crossed to a part for part II of the period concerned, and has constant current  $I_2$  with the larger average than  $I_m$ . The value  $I_1$  of the current in initiation of said period permits the attachment (diffuse stable arc attachment) of the stable diffusion arc, therefore the thermionic emission of the electrode (emitting electrode) which is emitting the lamp. an above-mentioned example -- setting -- a ratio --  $I_e/I_m$  has a value 0.9 and Ratios  $t_1/t_p$  have a value 0.5.

[0018]

Drawing 4 shows the lamp current of other examples. In this example, the current covering a part for part I of the period concerned is uniformly held with the value which permits thermionic emission in initiation of this period.

[0019]

The current as a result depended on other desirable examples is shown in drawing 5. In this case, the current  $I_1$  in initiation of the period concerned is higher than  $I_e$ .

[0020]

Drawing 6 shows the graph of the current by other desirable examples further. In this example, the pulse which has the same polar value  $I_3$  in a lamp current in the end of the period concerned is established. In actually realizing an above-mentioned example, the value of  $I_3$  is  $1.6I_m$ .

[0021]

The practical example of an above-mentioned circuit apparatus was used as an object for lighting of a Philips type UHP high-pressure discharge lamp. This lamp has the nominal power consumption of 100W, had the electrode distance of only 1.3mm, and was turned on with the current by drawing 4. The values of a current are  $I_e=0.93A$ ,  $I_m=1.25A$ , and  $I_2=1.33A$ . therefore, a ratio --  $I_e/I_m$  is 0.74. The duration  $t_p$  of a period is 5.6ms according to the clock frequency of the 90Hz rectification means II, and  $t_p(s)$  are ratios  $t_1/0.2$ . The suitable thing was shown when Philips P87C749EBP was programmed as a microprocessor MC to detect lamp voltage twice in each period. The lamp current between 8% was overlapped on the current pulse by drawing 6 in the second half of each \*\*\*\*\*, and a flicker was able to be considerably controlled in other practical examples which serve as the current  $I_3$  of  $1.4xI_m$  as the result.

[0022]

Lamp voltage is 85V in the lamp life of 100 hours, and showed the increment to 94V after lighting of 500 hours. The same lamp was made to turn on with the circuit apparatus by the conventional technique for a comparison. In this case, lamp voltage increased to 110V after lighting of 85V in 100 hours to only 300 hours.

[Brief Description of the Drawings]

[Drawing 1]

Rough drawing of the circuit apparatus by this invention is shown.

[Drawing 2]

The control means of the example of the circuit apparatus by this invention of drawing 1 is shown.

[Drawing 3]

It is the graph of the lamp current offered by the equipment by drawing 1 .

[Drawing 4]

It is the graph of the lamp current by the desirable example of said circuit apparatus.

[Drawing 5]

It is the graph of the lamp current by other desirable examples of said circuit apparatus.

[Drawing 6]

It is the graph of the lamp current by other desirable examples of said circuit apparatus further.

[Description of Notations]

K1 -- input terminal K2 -- means  $\Pi$ -- commutator III-- which generates input terminal I-- direct-current supply current -- control means La-- high-pressure discharge lamp L1 -- terminal L2 -- terminal L3 -- node SC-- switching circuit MC-- microcontroller 1 -- input section 2 -- input section 3 -- output terminal 4 -- input section 5 -- input section P1 -- the contact pin P3 -- contact pin O-- output section

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[Translation done.]

## \* NOTICES \*

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

[Drawing 1]

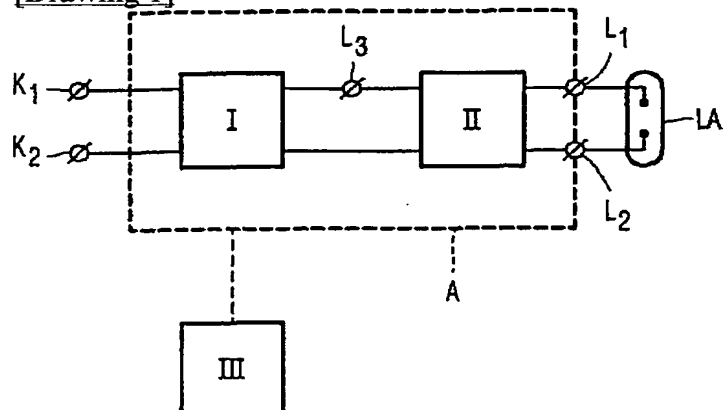


FIG. 1

[Drawing 2]

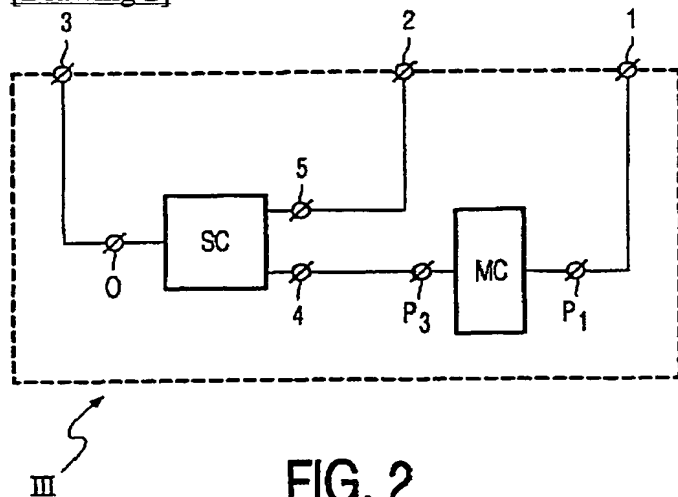


FIG. 2

[Drawing 3]

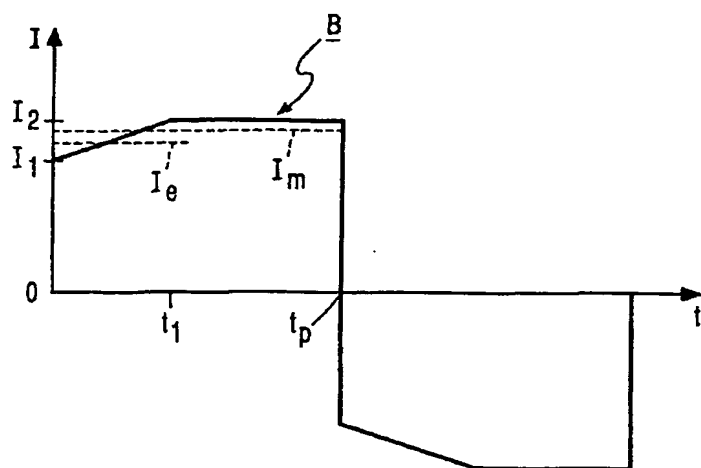


FIG. 3

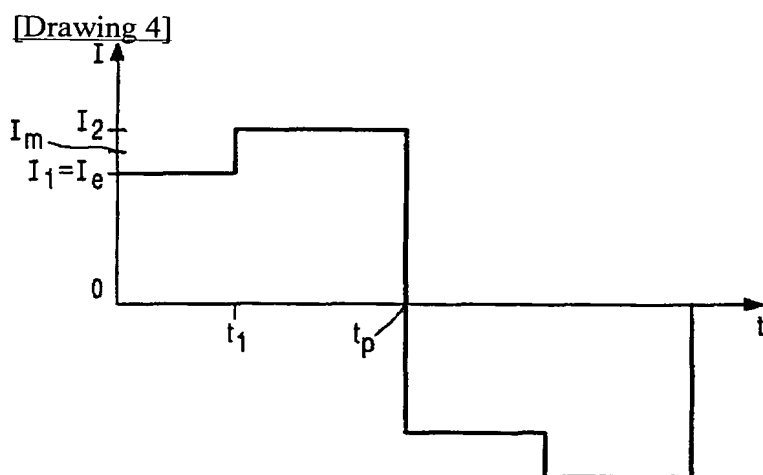


FIG. 4

[Drawing 5]

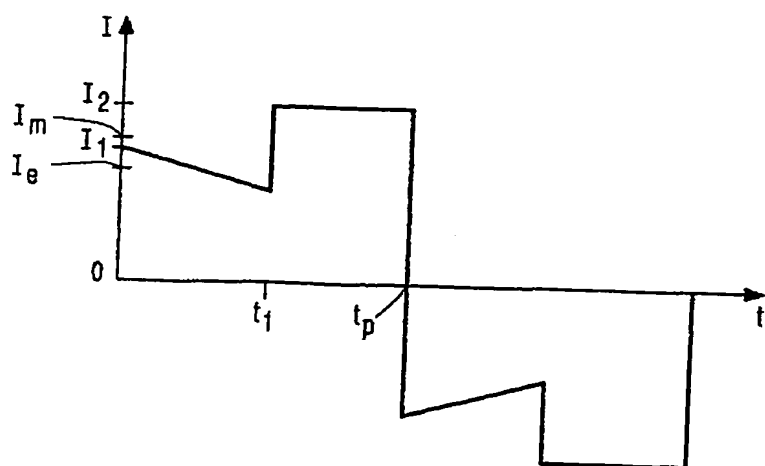


FIG. 5

[Drawing 6]

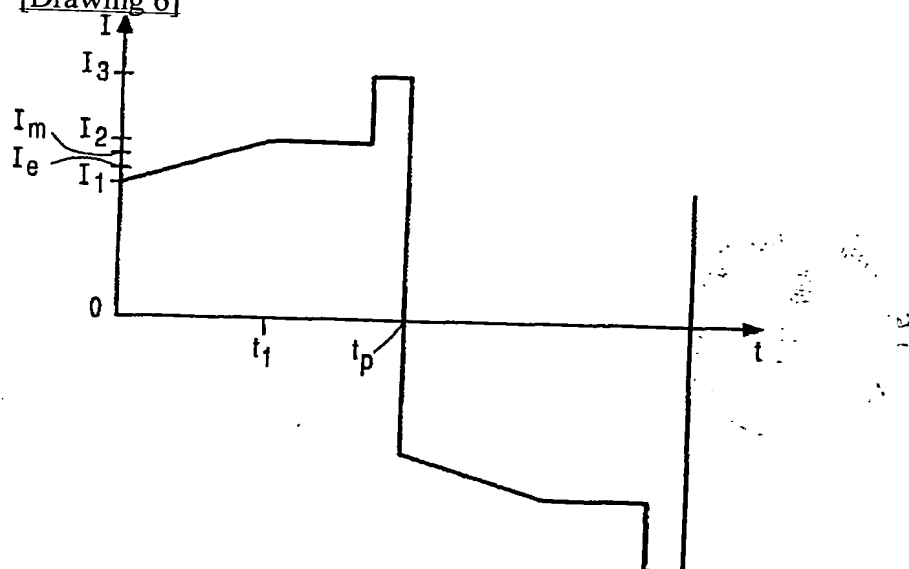


FIG. 6

[Translation done.]